



Braking

Braking Test Description

The braking tests were based on procedures described in the *Code of Federal Regulations* (CFR), Title 49, Parts 571.135 and 571.105.

The following measurements, based on Part 571.135 (Federal Motor Vehicle Safety Standard 135), paragraph S7.5 "Cold Effectiveness," were taken:

- Minimum stopping distance with no wheel lock-up from 100 km/h (62 mph) on dry pavement
- Minimum stopping distance with no wheel lock-up from 50 km/h (31 mph) on wet pavement

The following measurements, based on Part 571.105 (Federal Motor Vehicle Safety Standard 105), paragraph S7.17 "Spike (Panic) Stops," were taken:

- Maximum brake pedal force stopping distance allowing wheel lock-up or anti-lock braking system (ABS) activation from 50 km/h (31 mph) on dry pavement
- Maximum brake pedal force stopping distance allowing wheel lock-up or ABS activation from 50 km/h (31 mph) on wet pavement

The ballast condition for all measurements was "lightly loaded vehicle weight," which is defined as unloaded vehicle weight plus 180 kg (396 lb), including driver and instrumentation.

Dedicated AFVs and gasoline control vehicles were tested once on their designated fuel. FFVs were tested on alternative fuel because braking performance was not expected to be affected by the fuel used in the vehicle. Bi-fuel vehicles were tested on both fuels, because the added weight of the additional tanks and fuel might affect the braking results.

Braking Test Preparations

In addition to the tasks indicated in General Test Preparations, technicians performed the following pre-test tasks:

- Dimensional measurements of the front and rear brakes were taken to confirm that the brake systems of both vehicles were identical.
- The brake discs and drums were resurfaced.
- Thermocouples were installed in new OEM brake linings.
- The thermocoupled brake linings were fitted to the vehicles.
- The vehicles were weighted to the appropriate ballast conditions.
- Brake system specification sheets were completed.
- The tire pressures were set to placard values.
- Brake test instrumentation was installed including brake temperature, pedal force, and fifth wheel displays.
- A 200-stop brake burnish procedure was completed to condition the brakes.



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Braking Test Procedures

Immediately prior to testing, the tire pressures were re-checked and adjusted if necessary. The vehicles were also weighed with the driver, instrumentation, and ballast in place and technicians made final weight adjustments and recorded test weights.

All dry pavement stops were performed on the Skid Pad, a straight, multi-lane facility 2 miles in length. The stops were performed in the same direction on the Skid Pad's 1% downgrade. The peak braking coefficient of the brake test surface on the Skid Pad was 0.94 as monitored by a skid measurement system.

All wet pavement stops were performed on the wet braking test pad of the Vehicle Dynamics Area (VDA). The wet braking pad is an asphalt surface coated with Jennite, an asphalt sealer. The wet pavement stops were performed in the same direction perpendicular to the 1% grade of the VDA. The peak braking coefficient of the wet braking surface was 0.32. A tank truck applies water regularly during test sessions to maintain the coefficient.



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After each stop, the actual test speed, the measured stopping distance, the brake temperatures, and the average pedal force were recorded from the instrumentation.

Between stops, the brake lining temperatures were monitored and allowed to cool to 100 degrees C (212 degrees F) before proceeding with the next stop.

The vehicles' transmission gear selectors remained in drive throughout the tests.

Dry Pavement Cold Effectiveness Stops

From 100 km/h (62 mph) the test vehicles were braked to a stop in the shortest distance achievable with a maximum pedal force of 500 Newtons (112 lb). For each configuration, a total of six braking stops were completed.

Wet Pavement Cold Effectiveness Stops

From 50 km/h (31 mph) the test vehicles were braked to a stop in the shortest distance achievable with a maximum pedal force of 500 Newtons (112 lb). Six braking stops were also completed for each configuration during the wet pavement tests.

Dry Pavement Panic Stops

From 50 km/h (31 mph) the test vehicles were braked to a stop with a pedal force of no less than 890 Newtons (200 lb). A total of six braking stops were completed for each configuration with drivers making no attempt to steer.

Wet Pavement Panic Stops

From 50 km/h (31 mph) the test vehicles were braked to a stop with a pedal force of no less than 890 Newtons (200 lb). For each configuration, a total of six braking stops were completed, with drivers making no attempt to steer.

Final test results were the average of the six stops for each test.

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